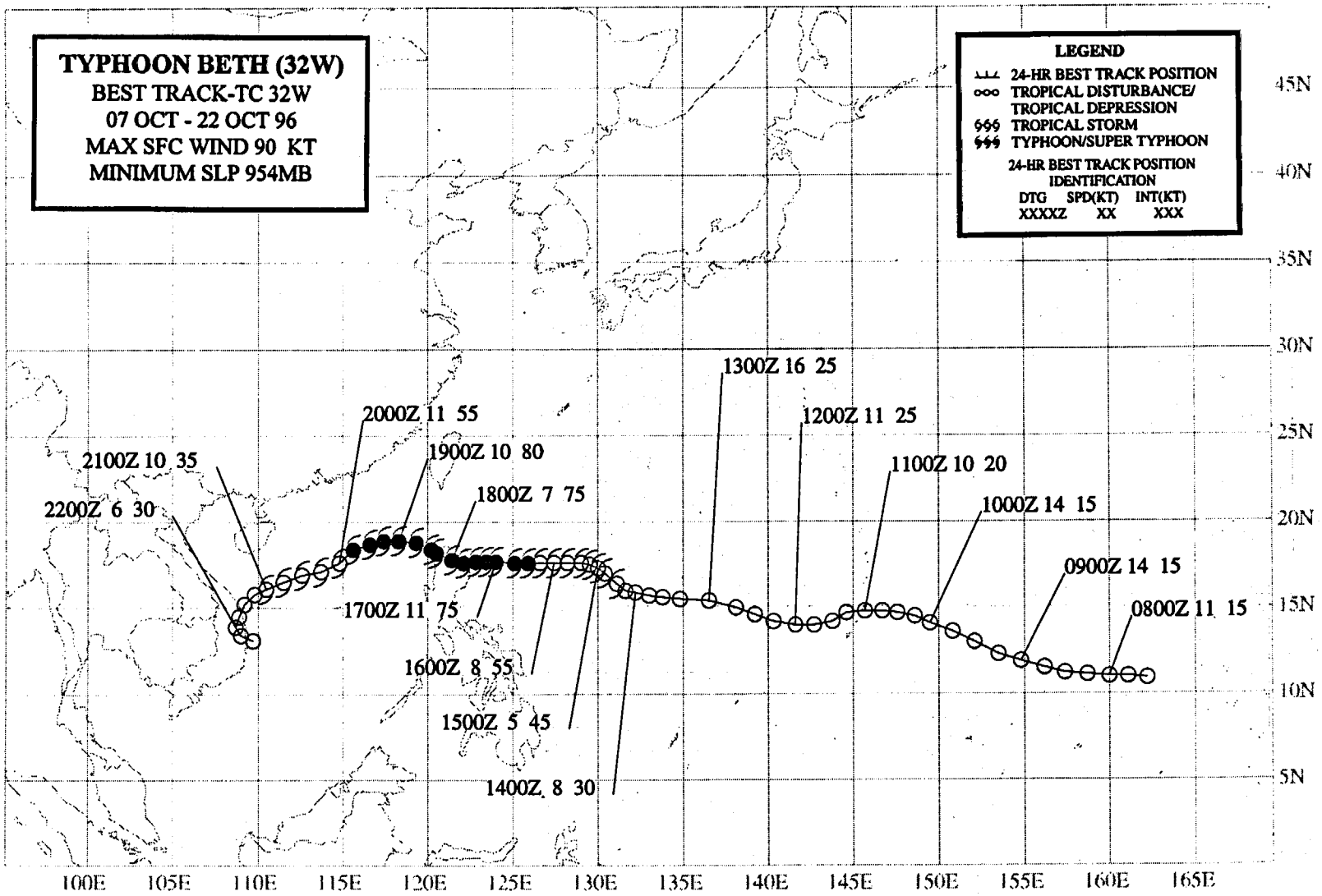
TYPHOON BETH (32W)
BEST TRACK-TC 32W
07 OCT - 22 OCT 96
MAX SFC WIND 90 KT
MINIMUM SLP 954MB
LEGEND
24-HR BEST TRACK POSITION
TROPICAL DISTURBANCE/ TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON/SUPER TYPHOON
24-HR BEST TRACK POSITION IDENTIFICATION
DTG SPD(KT) INT(KT)
XXXXZ XX XXX
2100Z 10 35
2200Z 6 30
2000Z 11 55
1900Z 10 80
1800Z 7 75
1700Z 11 75
1600Z 8 55
1500Z 5 45
1400Z 8 30
1300Z 16 25
1200Z 11 25
1100Z 10 20
1000Z 14 15
0900Z 14 15
0800Z 11 15
45N
40N
35N
30N
25N
20N
15N
10N
5N
100E
105E
110E
115E
120E
125E
130E
135E
140E
145E
150E
155E
160E
165E

TYPHOON BETH (32W)

I. HIGHLIGHTS

The tropical disturbance which became Beth was first detected in the eastern Caroline Islands. It developed very slowly, and four Tropical Cyclone Formation Alerts were issued on the system prior to the first warning. Passing over Guam, it produced a thunderstorm with a spectacular display of cloud-to-ground lightning (unusual in the maritime tropics). Beth became a typhoon in the Philippine Sea and passed over Luzon where loss of life was reported. Encountering the northeast monsoon in the South China Sea, it turned to the southwest, weakened, and made landfall in central Vietnam.

II. TRACK AND INTENSITY

For much of October, winds throughout most of Micronesia were light and variable in association with a weak monsoon trough. Deep convection (loosely organized into discrete ensembles of MCSs) was located in an east-west zone across the low latitudes of the WNP. Several of the tropical disturbances in this maximum cloud zone became significant TCs. The first TC of October, Abel (30W), originated from a monsoon depression in this cloud band. The next two TCs — Tropical Depression (TD) 31W and Beth (32W) — developed simultaneously during the middle of the month (Figure 3-32-1). The tropical disturbance which became Beth originated in the eastern Caroline Islands. It was first mentioned on the 071800Z Significant Tropical Weather Advisory. The system moved westward, and in the late afternoon of 11 October, synoptic data from Guam and Saipan, visible satellite imagery, and NEXRAD products indicated that a weak LLCC was associated with an area of increasing deep convection near Guam and Saipan. This prompted the JTWC to issue the first TCFA at 110730Z. At 111200Z, a second TCFA was issued in order to reposition the alert box to account for indications on NEXRAD data that a second LLCC had formed to the east of Guam. At 120130Z October, a third TCFA was issued to move the alert box further to the west to incorporate indications on visible satellite imagery that the primary LLCC had moved to a position 260 nm (480 km) west of Guam. The pre-Beth tropical disturbance moved west and did not intensify, although conditions still appeared favorable for further development, and a fourth TCFA was issued at 130000Z. During the night of 13 October, the deep convection in the pre-Beth tropical disturbance consolidated near the LLCC and became organized into a well-defined curved band. The first warning, valid at 131200Z, was issued on Tropical Depression (TD) 32W. The cloud pattern of TD 32W evolved into a sheared pattern type with the LLCC exposed on the eastern side (Figure 3-32-2). When satellite imagery indicated an intensity of 35 kt (18 m/sec), TD 32W was

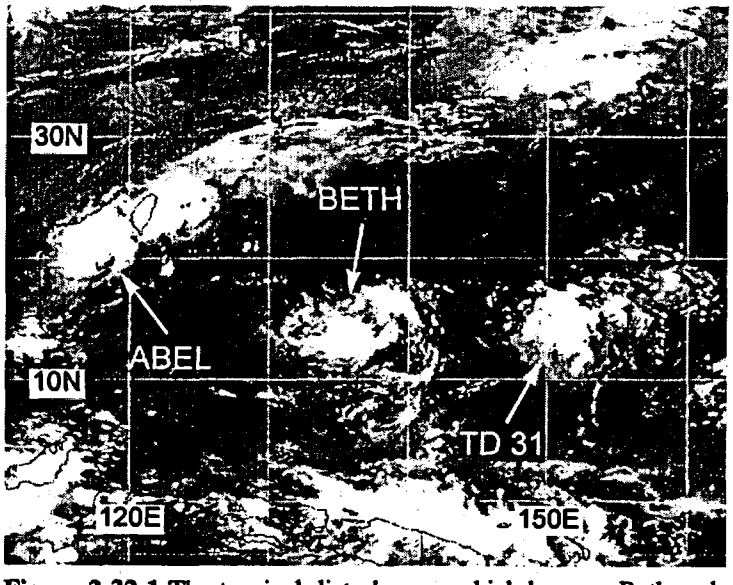

Figure 3-32-1 The tropical disturbances which became Beth and TD 31W developed simultaneously while Abel (30W) moved across the South China Sea (122331Z October infrared GMS imagery).

upgraded to Tropical Storm Beth on the warning valid at 150000Z. Beth became a typhoon at 161200Z and reached its peak intensity of 90 kt (46 m/sec) at 171200Z just prior to landfall on the east coast of northern Luzon (Figure 3-32-3). While crossing northern Luzon, Beth weakened only slightly to 75 kt (39 m/sec), and then reintensified to 80 kt (41 m/sec) at 181200Z when it entered the South China Sea. The period of reintensification was short-lived and by the morning of 20 October, the deep convection became sheared to the east of Beth's LLCC as the system weakened steadily over water. As Beth began to weaken, it began to move toward the west-southwest in response to high pressure over southern China and a strengthening of low-level northeasterly flow to its west and north. The final warning was issued, valid at 211800Z, as the poorly defined LLCC reached the coast of central Vietnam and dissipated.

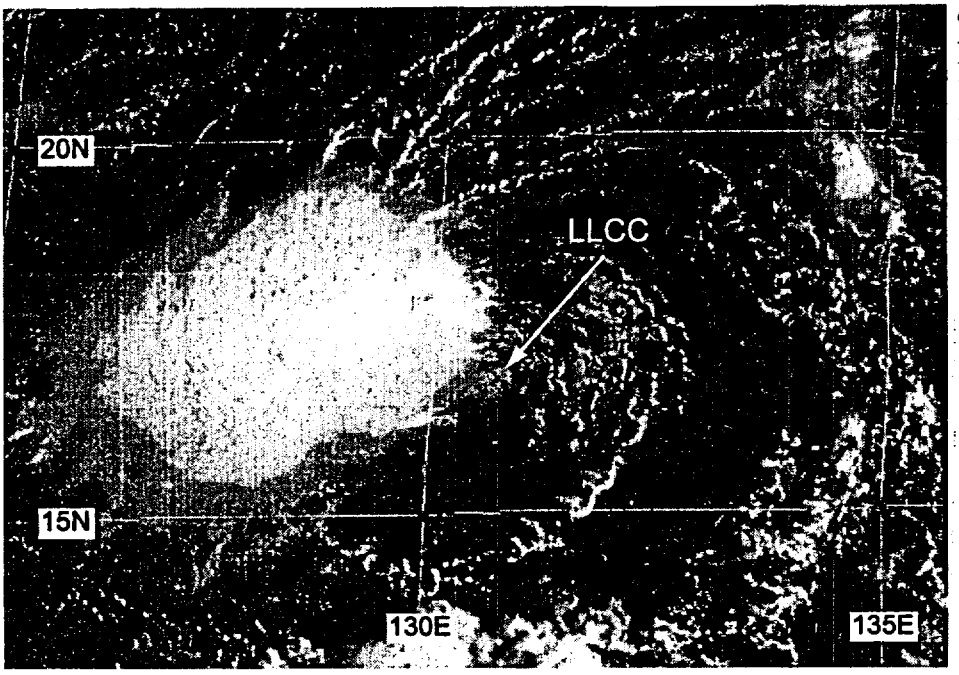

Figure 3-32-2 Beth's LLCC is partially exposed to the east of the deep convection, indicating the presence of easterly vertical wind shear (142224Z October visible GMS imagery).

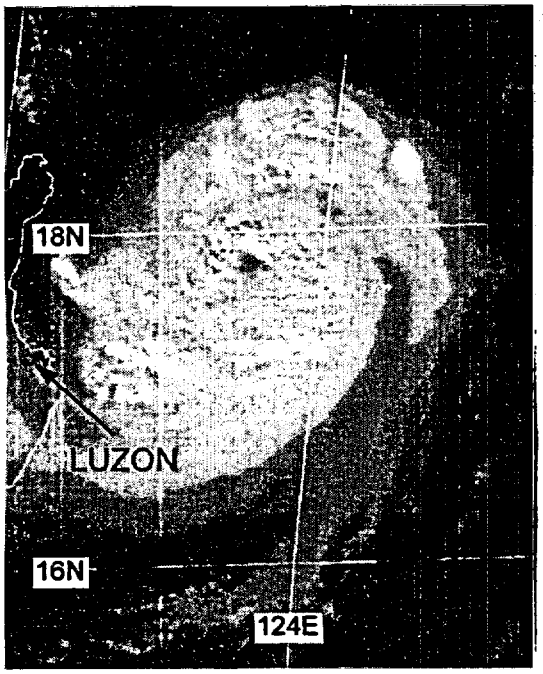

Figure 3-32-3 Beth acquires a small visible eye shortly before reaching peak intensity (170424Z October visible GMS imagery).

III. DISCUSSION

a. *Lightning in the maritime tropics*

On the night of 11 October, a thunderstorm associated with the pre-Beth tropical disturbance produced a spectacular display of cloud-to-ground (CG) lightning on Guam. Frequent CG lightning is rare on Guam, even in large cumulonimbus clouds with tops exceeding 50,000 ft. Indeed, lightning frequencies are low in general over the maritime regions when compared with lightning frequencies within thunderstorms over large land areas (Orville and Henderson 1986). The cause of reduced lightning frequencies in maritime cumulonimbus clouds has been narrowed to two primary mechanisms:

1) reduced vertical velocities in maritime thunderstorms; and,

2) differences between the continental versus maritime aerosols which comprise the cloud condensation nuclei.

A more detailed discussion of the mechanisms of cloud electrification are beyond the scope of this summary.

In the case of the relatively frequent CG lightning discharges in the 11 October Guam thunderstorm, only one other unusual factor was noted: reflectivity values as high as 60 dBZ on the NEXRAD composite reflectivity product persisted in the core of the thunderstorm as it moved southwestward across Guam.

b. *Intensification of a sheared TC*

One of the factors known to influence genesis and development of a TC is vertical shear of the horizontal wind: too much shear, and the TC is torn apart. Zehr (1992) found that an 850-200 mb wind shear of 15 kt (8 m/sec) or greater was unfavorable for TC genesis and development. On the morning of 15 October, Beth possessed a shear-type cloud pattern (Figure 3-32-2), and the LLCC was partially exposed on the east side of the deep convection. Shear is often detrimental to the further development of a TC. In Beth's case, however, the system intensified despite the shear and by 17 October, Beth was a typhoon with a visible eye and a symmetrical pattern of cirrus outflow (Figure 3-32-3). It is a difficult forecast problem to determine whether vertical shear is going to inhibit development, or whether the TC will continue to develop despite a shearing environment. Fundamental questions remain in the case of intensification in a sheared environment: does the TC outflow manage to overcome the shear? Does the shear decrease? Do changes occur in its vertical profile?

IV. IMPACT

At least three people were reported dead after Beth moved across the northern Philippines. The TC tore away roofs, smashed windows, and triggered floods. In the hardest-hit province of Cagayan, Beth damaged municipal buildings and crops, and eroded roads.